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The President's Page

RIGHT UNDER YOUR FEET

I had an old friend once, a distinguished professor of mineralogy and a graduate of the old mining school of Freiburg, who was called upon frequently to give a famous lecture entitled "Right Under Your Feet." It was a great talk, because he guided his audience through Nature's vast laboratory, pointing out now this wonder and now that one, unfolding bit by bit each marvel that became simple after all to understand, until the world of minerals was apparent and real to all of us; and many of us who had strode over them, not seeing or understanding them, stepped out of the lecture hall into Nature's Laboratory to find them where we had least expected—right under our feet!

In our elementary courses we teach science too much inside and not enough from the outside. Many of our highway accidents come about because too many people with no outside interests are trying to escape from themselves by driving from one place to another where "places" become merely empty objectives. We are not training people in our grammar schools and high schools to pause and study a rock outcrop, to examine an interesting plant or insect, or through training in observation to become fond of the outside world. *Geology and mineralogy are not taught in our free public schools;* thus, neither teacher nor pupil has any adequate way of learning about rocks and minerals, fossils, and structure, from which we discover the history of the earth.

Knowledge of minerals may lead to wealth because it encourages production of our mineral resources; also, it affords hours of pleasant relaxation and study for many, and leads to the increase of knowledge. As in the case of all real values, we cannot estimate its worth to our young people or its transfer value to future generations in terms of dollars and cents. Understanding and knowledge of the world about us is a miracle to youth, an incentive to labor among the mature, and a comfort to old age. There is an important place for the Earth Sciences in that old commandment, "Remember thy Creator in the days of thy youth."

Once after I had begun the study of geology, an old man said to me in referring to a certain valley, "I suppose this valley has been here since the world began." It set me to wondering about the great many people who feel that Nature's work is finished or who fail to perceive changes in biology and geology because processes are slow. And yet evidence of change is so clear that the geologist can visualize the time when those rocks were not here or these mountains had not been formed. Then we recognize them as parts of an unfinished experiment in Nature's Laboratory where continuous change has taken place since the beginning, produced by processes that we may

study today, such as volcanoes in action, winds and rain, and the work of streams and waves. By intuition, the Roman poet, Lucretius, from his villa by the sea recognized it all before the Age of Science:

"Nothing abides. The seas in delicate haze
Go off; those moonéd sands forsake their place;
And where they are, shall other seas in turn
Mow with their scythes of whiteness other bays."

—Titus Lucretius Carus (98-55 B.C.)

BENEFITS OF AFFILIATION WITH THE GEORGIA ACADEMY OF SCIENCE

According to the Constitution of the Georgia Academy of Science scientific organizations in Georgia may become affiliated with the Academy. In order to be an affiliate, at least 5 per cent of its members in good standing must belong to the Academy. No assessments or other obligations are required. Request for affiliation must be approved by the Executive Council at least six months prior to the vote of Academy membership at its annual meeting.

The affiliated organization is expected to elect a representative who will sit and consult with the Council of the Academy. This will offer the opportunity to men and women in diverse fields of scientific research of meeting with each other and discussing various problems related to their mutual fields of science. At the present time, most of us are not familiar with, and have not even heard of, a large number of important scientific organizations which are active on a statewide basis. A state academy of science should be all-inclusive for the state, and should serve as a clearing house of information.

The affiliated society, or organization, has privileges of meeting with the Academy, and of attending meetings of the Academy, or reading papers, and of submitting papers for publication in the Bulletin. It is the desire of the Academy to increase the size, quality, and scope of the Bulletin, which is its quarterly publication. This Bulletin contains articles on the various branches of science, and also news notes on the activities of the affiliated societies.

The Senior Academy of Science sponsors and encourages the activities of the Georgia Junior Academy of Science. In the latter case, the young people of the State are encouraged to engage in scientific research, and each year a science fair is held where young people in our high schools compete for prizes with exhibits covering all branches of science. The leading exhibitors then have an opportunity of competing with other State winners for national prizes. It is a most worthwhile undertaking to encourage these young people. Affiliated organizations could do much good by assisting in this movement and they would, at the same time, be advertising their particular branch of science to the young people of the State.

Of course, it is impossible in advance to enumerate the mutual advantages to be derived from this type of coordinated effort. We

may feel sure that such an alliance will be beneficial to both the Academy and the affiliated organization, and that it will discover new advantages through the years.

WHAT THE COLLEGE EXPECTS OF THE HIGH SCHOOL STUDENT*

WALTER EDWARD MCNAIR, Agnes Scott College

Any high school teacher noting my topic for the afternoon will most likely laughingly remark, "Why, the answer to that question is easy; colleges expect the impossible!" Well, paradoxical as it may seem, they do expect the impossible; and if they didn't, they would hardly be worthy of the name of college. For you see the process of education is an idealistic endeavor as well as a practical one, and if we do not set our aims in the realm of the impossible, we shall by just so much lower the achievement which we make in striving for those lofty goals. Thus, at the outset, I wish to establish, as a frame for my remarks, the ideal—if you please, the impossible—and then proceed to suggest a few basic areas in which colleges may well be justified in certain expectations regarding students desiring entrance.

However, before we attempt to take up these areas of expectation, it may be well, by way of justifying collegiate demands, to define what the college is trying to do. Colleges are striving to educate the whole man, to give him foundation and perspective and not, as some may think, to make specialists out of students—a task which properly belongs to the graduate or professional school. We seek to produce a liberally educated person because that sort of education is "the rightful possession of every human being."[1] Defining this sort of educated person, the excellent little volume entitled *General Education in School and College* has put the matter this way:

> The liberally-educated man is articulate, both in speech and writing. He has a feel for language, a respect for clarity and directness of expression, a knowledge of some language other than his own. He is at home in the world of quantity, number, and measurement. He thinks rationally, logically, objectively, and knows the difference between fact and opinion. When the occasion demands, however, his thought is imaginative and creative rather than logical. He is perceptive, sensitive to form, and affected by beauty. His mind is flexible and adaptable, curious, and independent. He knows a good deal about the world of nature and the world of man, about the culture of which he is a part, but he is never merely 'well-informed.' He can use what he knows, with judgment and discrimination. He thinks of his

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*Read in Science Education Section, Georgia Academy of Science Meeting, Dahlonega, April 23, 1954.

> busines or profession, his family life, and his avocations as parts of a larger whole, parts of a purpose which he has made his own. Whether making a professional or personal decision, he acts with maturity, balance, and perspective, which come ultimately from his knowledge of other persons, other problems, other times and places. He has convictions which are reasoned, although he cannot always prove them. He is tolerant about the beliefs of others because he respects sincerity and is not afraid of ideas. He has values, and he can communicate them to others not only by word but by example. His personal standards are high; nothing short of excellence will satisfy him. But service to society or to his God, not personal satisfaction alone, is the purpose of excelling. Above all, the liberally educated man is not a type. He is always a unique person, vivid in his distinction from other similarly educated persons, while sharing with them the traits [and qualities just enumerated].[3]

If one accepts this statement as setting forth the kind of person the college desires to produce, it immediately is apparent that nothing short of the highest expectations concerning the calibre of entering high school students can lead to the ideal end product from the college. What then are some things which the college may reasonably expect of these students?

In the first place the student entering college should recognize the value and necessity of work. It is appalling how many people today espouse the "get-by attitude"—students who are blithely content merely to pass, rather than to achieve. The whole philosophy of "following the line of least resistance," of putting things off till tomorrow in the hope that they won't have to be done is a commentary on a serious malady of contemporary life. Shoddy, slovenly work, resulting from inferior, lazy thinking is too much the order of the day. In this connection it is interesting to note that in a relatively recent article in the Atlanta Sunday paper there was chronicled a list of seven modern deadly sins, namely, "pleasure without conscience, cleverness without character, science without humanity, wealth without work, industry without morality, politics without principle, and religion without reality."[3] Now a comparison of this list with the mediaeval group of deadly sins—pride, lust, covetousness, envy, gluttony, anger, and sloth—reveals that the only deadly sin common to both lists is laziness—sloth on the one hand and "wealth without work" on the other. Well may it be that every teacher should instill in his students Carlyle's great beatitude, "Blessed is he who has found his work; let him ask no other blessedness,"[4] and at the same time warn students of the deadly ramifications of shoddy endeavor, that in the words of George Eliot's Adam Bede will be "like a bit o' bad workmanship—you never see th' end o' the mischief it'll do."[5] Rather we all must ring the changes on certain practices which are part and parcel of quality work. What then are some of these practices?

There is certainly the quality of having a positive, aggressive attitude towards ones task. Students who are on the defensive, who wait for someone else to chart the way, who never seize the initiative on their own are deficient in one of the basic attitudes leading to constructive work. For independence, the desire to venture, the will to assault are fundamental to success. Stephen Vincent Benét in writing of General Lee in *John Brown's Body* puts the matter of aggressiveness this way:

> This man could reason, but he was a fighter,
> Skilful in every weapon of defense
> But never defending when he could assault,
> Taking enormous risks again and again,
> Never retreating when he could strike
>
> . . . . .
>
> He was not mild with life or drugged with justice,
> He gripped life like a wrestler with a bull,
> Impetuously. It did not come to him
> While he stood waiting in a famous cloud,
> He went to it and took it by both horns
> And threw it down.[6]

Likewise in developing a proper facility in the area of work, there should be the quality of unrelenting perseverance or persistence in a task. Too many tire of an enterprise when the novelty is gone, but success comes to the person who stays day in and day out to the finish, like the tortoise in Aesop's fable. I understand that the celebrated pianist Josef Hoffman once remarked that if he went one day without practicing, he knew it; if he went two days, his friends knew it; and if he went three days, the whole world knew it. It is the same spirit which made Benjamin Disraeli vow after a poor reception of his first speech in Parliament that the day would come when he would be heard. And as a result of his tenacity of purpose that day did come when the House of Commons hung in rapt attention on his every word. This sort of perseverance is that which causes a runner in a race to churn the cinders of the track just as much at the finish line as at the starting mark, and like aggressiveness it is a basic quality in a constructive attitude towards work.

As a second consideration, it seems reasonable to ask that the prospective college student have some skill in the basic tools of learning—in reading, in writing, in the art of computation; yet how often is the contrary the case! In one manual on reading which I noted several years ago, it was stated that a student must be able to read at least 325 words a minute in order to do college work successfully. Speed, however, is not the final requisite; accuracy is even more important, and herein is required a mastery of words in all their shades of meaning. Some may be lifting the skeptical eyebrow even now at these fulminations, but I tell you, ability to understand and use words is important in any area of learning.

Witness the student in history who in a paper declared that people in the American Revolution wrote insulting letters to people in the French Revolution. Upon being questioned about this sentence, he triumphantly produced his textbook and pointed to this statement: "The American Revolution corresponded roughly with the French Revolution." Yes, an understanding of words is important. Let us go a step further. Sometime ask a group of average students to alphabetize a stack of fifty cards. The results may well be amazing and appalling. In the same way skill in spelling, in computation, in following specific directions enters into this problem of a student's being equipped with the basic tools for learning. He likewise must be able to write a clear, accurate sentence—one incapable of being misunderstood if he is to be able adequately to marshall the facts he may master; for facts in a vacuum are just so much wasted potential. No person in reality is master of a subject unless he can discuss it in writing with lucidity, simplicity, vitality, and variety, to borrow terms from Somerset Maugham.[7] Thus, no student should be launched on the sometimes stormy sea of college work without having at hand the implements for successful understanding and mastery; and it is the business of *all* his high school teachers to cooperate as one in seeing that skill in these prerequisites to learning are the possession of each student.

In the third place the ability to evaluate, to judge, to discriminate must be present. We think here not of judging between the good and the bad, although that ability is important. Rather we have in mind the discriminating between the good and the best. Life is entirely too short to waste it on the merely good when one can have the best. And some ability to cut straight through to the best, to the basic, to the fundamental is a must for successful work in college. Sir Richard Livingstone, the noted Oxford educator, has remarked that the purpose of all education is ". . . to give a sense of values and the power of distinguishing . . . what is first rate from what is not."[8] Thus, one of the primary responsibilities of any teacher lies just here in inculcating in a young man or young woman a high sense of values, the skill to make wise choices in the realm of time, of effort, and of personalities. Moreover, the instructor must ever be vigilant that this sense of values is not limited to the material alone, to that which can be weighed and measured and calculated and observed, to that which is convertible to dollars and cents. Someone has remarked that a cynic is a man who knows the price of everything and the value of nothing. The good teacher, however, concentrates on the *what* and not on the *how much*. I realize that I am suggesting a difficult task, for we are in an age which as a means of evaluating uses cost or price or material rather than usefulness or beauty or quality or service. Nevertheless any student coming to college should have a beginning made on the sharpening of his sensitivity to true, intrinsic, lasting worth.

Finally, and perhaps most important, any teacher worth his salt should inculcate in a student both a zest and a reverence for learning and knowledge. For indeed there is no more exciting arena than

the mind, and the work of the teacher is to keep a virtually continual ferment of intellectual challenge alive in the mind of the student. Yet at the same time the youth must not become so self confident that he loses the sense of awe and mystery in the presence of knowledge. Hear Thomas Carlyle in *Sartor Resartus* when he declares:

> I mean that Thought without Reverence is barren, perhaps poisonous; at best, dies like cookery with the day that called it forth; . . . The man who cannot wonder, who does not habitually wonder (and worship), were he President of innumerable Royal Societies, and carried the whole *Mecanique Celeste* and *Hegels Philosophy*, and the epitome of all Laboratories and Observatories with their results, in his single head, — is but a Pair of Spectacles behind which there is no Eye.[9]

A sense of reverence and wonder must be a part of the good student, yet not a reverence for something divorced from life; for the true reverence is for the true reality, and nothing is more real and alive and vital than a man's mind and its powers.

One must be careful also to give to a student a spirit of humility and a recognition of his own limitations. What is more insufferable than the arrogance of some resulting from a false notion of their own superiority! I have heard that once a traveller "breezed into the Louvre, spent an hour racing up and down the corridors, casting an eye hither and yon, and then departed, remarking to the guard at the door, "Not a thing in here worth seeing.' To which sally the guard calmly replied, "Sir, these treasures are not on trial; you are." In the same way knowledge and its worth are not on trial, but the student is; it is the business of the teacher to cause the boy or girl to realize this fact that he or she stands humbly in the presence of the accumulated wisdom of the ages.

So we say that the college which desires to turn out the well integrated, liberally educated graduate asks of the high school that students coming forward know the worth of work and how to engage in it, have at least a bowing acquaintance with the basic tools of learning, be adept in the "fine art of discrimination," and feel both zest and reverence and humility in the presence of knowledge. These four basic "musts" for the college freshman result from the handiwork of all his teachers—including those concerned with science who strive not merely to impart a scientific knowledge but to mold a developing mind and intellect as well and to foster and promote habits and attitudes conducive to a continuing process of learning.

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WHAT IS HORTICULTURE AND WHAT DOES HORTICULTURAL RESEARCH INCLUDE

FRANCIS E. JOHNSTONE, JR., *Chairman*
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For some time I have been disturbed and perplexed by an apparently increasing confusion in the minds of many of my colleagues in other scientific fields as to just what horticulture is and what kinds of research horticulturists engage in. This discussion is an attempt to clarify both of these questions.

Horticulture has been variously defined. Most dictionaries call it "the art or science of cultivating gardens and orchards." Most of the older writers conveyed the idea of confinement of the above operations to a small area, particularly a walled or otherwise enclosed area adjacent to a residence. Today, however, practically all informed persons agree that horticulture includes the culture of fruits, flowers and other ornamentals, and vegetables, no matter what the size of the operation.

Over a period of time certain crops have become known as horticultural crops. It is sometimes hard to explain just what the characteristics of a horticultural crop are. The earlier writers distinguished horticultural crops from field crops by assigning to the first classification all of those plants usually grown in a small enclosed area, and to the latter group all plants cultivated in open fields. We still use the term "field crops" for all that group of plants which formerly were generally cultivated on a field scale. However, today many of our so-called horticultural crops are likewise cultivated in open fields and sometimes to the extent of hundreds or even thousands of acres in single plantings.

More recently the term "truck crops" has been assigned to vegetable crops which are cultivated on a large scale. The principal criterion that horticulturists generally apply to distinguish truck crops from field crops is their perishability. Perishable crops require special harvesting and handling techniques. They are not generally adapted to storage, especially ordinary farm storage. Admittedly this criterion is one of degree, and in the case of Irish potatoes and sweet potatoes we have two crops which are sometimes classed as field crops and sometimes as truck crops. Another criterion is the

end use of the crop. Those consumed in the fresh state are generally considered horticultural and those which are dried or manufactured into so-called staple foods are classed as agronomic or field crops. Here again it is hard to draw a definite line. Why for example are peanuts almost always grouped with the agronomic crops and pecans with horticultural crops?

As the science of horticulture has progressed it has expanded and some of its special branches have in themselves assumed major importance so that in many administrative organizations they have become separate and distinct fields of endeavor. The field of food processing has evolved largely from the efforts of horticulturists to find means of preserving and expanding uses of their highly perishable products. In some cases the processing of meat and dairy products has been combined with the processing of horticultural food crops to make single composite units of food processing. In other cases food processing is still administratively a part of horticulture.

Likewise the art or science of landscape architecture evolved from the efforts of horticulturists to find uses for ornamental plants. The first term applied to this field of work was "landscape gardening" and as such, much emphasis was placed on the culture as well as the arrangement of plants. More recently the architectural and engineering features have grown to the extent that the landscape architect gets most of his training in art, architecture, and engineering. His interest in horticulture has been reduced, perhaps unfortunately, largely to a consideration of the physical form, color, and size of plants, and their adaptation to local climate and soil.

Because of the great diversity of plants generally considered horticultural in nature, administrative officials have often assigned cognizance of new and untried or unusual plants to the horticulturists for consideration. Thus it was that forestry has historically been evolved through the horticultural departments of land-grant colleges. Today in many states forestry has not only been separated from horticulture, but has also been put on a par with the general field of agriculture itself. Research on sesame, by most definitions a field crop, has been carried out in this country largely by horticulturists principally because of its newness to our agriculture.

We conclude therefore that it is impossible to assign a hard and fast definition to horticulture which will include all the activities and crops with which horticulturists are today actively concerned and exclude related activities or crops which are considered outside the field of horticulture. However, for my logical minded colleagues, I offer the following rather loose definition.

Horticulture is a broad field of endeavor concerned with the culture, harvest, handling, storage, and marketing of food crops which are mostly highly perishable unless preserved by special techniques, and of flowers and ornamentals. The science of horticulture is a management science in that it utilizes facts and principles obtained from a number of other sciences such as botany, genetics, entomology, soils ,etc., to determine certain interlocking facts and overall principles peculiar to horticulture.

Horticultural research may be divided into three categories. They are: (1) Service or testing, (2) research investigations with a definite practical application in view, and (3) fundamental or basic research which has as its objective the establishment of facts, the practical objective of which may not be immediately apparent. The latter two categories naturally grade into each other and sometimes are carried along simultaneously. It is my opinion that few real fundamental facts are discovered or established without the researcher having in mind an application of the thing he is attempting to discover or establish. The application may be rather hazy in his own mind and he may not be able to convey it satisfactorily to persons less informed on the subject, nevertheless it is there. However, sometimes in the process of experimenting he stumbles on other perhaps even more important facts or truths.

When research depends on public funds for support, it is much easier to maintain an adequate budget if projects do have a clearly expressable practical objective. Consequently most horticultural research falls into the first two categories with fundamental facts being sought as tools for further advancement when presently known facts become inadequate.

There is a serious question in the minds of some persons as to whether or not so called service or testing research should be classified as research. Into this category fall such things as variety test ing, certain fertilizer tests, routine testing of new insecticides and fungicides, testing of various other chemicals as to their effectiveness for various horticultural purposes, etc. There is no question as to the value of this work. It probably returns more immediately in dollars and cents to the taxpayer than any other kind of research. However, it is routine. Methods are more or less cut and dried. Once the project is outlined, it does not take a high degree of training to carry it out. For this reason service or testing research may be a wasteful use of highly trained personnel.

However, in horticulture we have numerous requests for information obtained by testing, and consequently carry on much of this type of work. We test new varieties of fruits, flowers, vegetables and ornamentals for adaptability to local conditions. We test new insecticides and fungicides, both as to effectiveness for destruction of the pests and as to their effect on the plants themselves. Our horticulturists run routine fertilizer tests to discover best amounts and combinations of fertilizers to use on the various soil types with different crops. The results of all these tests are of immediate practical importance to the farmer and gardener, and are embodied in recommendations made through the horticultural specialists of the Agricultural Extension Service and in countless replies to letters of inquiry received by all the experiment stations.

In defense of the testing type of research, it might be said that it compares favorably with the botanical project which finds and classifies the flora of a region or locality in accordance with a taxonomic scheme already outlined and keyed, or with the chemist who tests

chemical after chemical on a particular substance to induce a desired reaction. All are dependent more on a knowledge of previous facts and principles and perseverance and work than on originality or brilliance on the part of the investigator.

In the second category of research as outlined above, we generally place projects requiring more specialized knowledge and training and in which the procedure of investigation is less routine, requiring more originality and ingenuity on the part of the investigator. Such things as breeding new varieties of plants; determining cause and remedy for unkown plant illness; working out systems of intercropping or management; determining relations between the form or quantity of internal constituents of a plant and the degree of cold or heat it will withstand; etc., are examples of applied research in this category.

Among so called fundamental or basic work being carried on by horticulturists in Georgia are: a study of the distribution of the essential element magnesium in the plant during the different seasons of the year; a study of the effect of forcing additional air into and through the soil on root distribution and top growth; studies of the inheritance of certain characteristics in the tomato; a study of the cause of the short lives of peach trees planted after peaches; and studies on the ability of certain plants to obtain minor nutrients from relatively insoluble glass particles.

In a consideration of a so called fundamental research program it must be recommended that basic facts and fundamental truths are not frequently obtained. Often the evolution of a new idea or principle evolves from the efforts of various workers at different places so that it is hard to determine who should receive credit. This is particularly true in horticultural research, therefore, it is necessary sometimes to combine applied projects with the fundamental in order to satisfy administrative officials and legislators as to progress being made.

In conclusion it should perhaps be emphasized that agricultural research in general and horticultural research in particular is becoming increasingly cooperative in nature. It is seldom that one researcher carries through to completion in its entirety a single line of investigation and can claim complete credit for the results obtained. The great accumulation of specialized knowledge and techniques makes it difficult for one person to be able to be well enough informed and skillful enough in the various techniques to solve complete horticultural problems as they arise.

SEMI-CHEMICAL PULPING*

REAVIS C. SPROULL**

—Outline—

Introduction:

Opportunity for utilization of hardwoods.
Definition of terms.
Brief background.

Pulping Procedure:

General.
Specific example at Herty.

Defibering and Refining:

Purification and Bleaching:

Show samples of unbleached and purified bleached oak.

Process Control Tests:

Chemical.
Process.
Product.

Properties of Pulp and Paper:

Problems Not Solved:

(a) Bark removal.
(b) Dirt removal.
(d) Fiber losses.
(e) High bleach consumption.
(f) Pulp stablization.
(g) Methods for determining wood acids generated.

Economics

Introduction

When Dr. Charles Holmes Herty and others focused attention on the southern trees there was an abundance of choice pine. There still is an abundance but the demand for pine has increased and the relationship of quality pine to hardwoods and culled trees has changed markedly as the result of selective cutting.

The most recent survey[1] by the U. S. Forest Service shows that the area of pine forest dropped from 80 per cent to 70 per cent from 1935-1952 in the three southernmost forest units of the state (Figure 1). Hardwoods in the three Georgia units make up 36 per cent of the total wood volume. Also the percentage of culled trees has increased by about 118 per cent, of which hardwoods comprise more than 80 per cent.

To produce the most values for the most people uses must be found for these hardwoods. They are the soil fertility and growth of

* Read before Georgia Academy of Science, Dahlonega, Georgia, April 23 1954.

** Director—Herty Foundation, Southeastern Industrial Site, Savannah, Georgia.

several decades. These hardwoods present opportunity and a challenge, just as the pines did in the earlier days. In fact unless they can be used, the continuing expansion of the forest industries in the area is endangered and some areas of the state may suffer financially. The semi-chemical process utilizes hardwoods.

The semi-chemical process was first reported by Rue, Rawlings, Wells and Staidl (*Paper Trade J 83*, No. 13-50 (1926) and was called the neutral semi-chemical process. Sodium sulphite buffered with alkaline chemicals so as to maintain pH above 7 is generally used to minimize corrosion and prevent "burning" the pulp. Since the first report many modifications have been made in the basic formula and any process which involves mild chemical treatment followed by defibering in an attrition mill is often called semi-chemical. The Forest Products Laboratory at Madison, Wisconsin has explored many facets of semi-chemical pulping and established it on sound principles.[2] This paper will be concerned with the buffered sodium sulphite process only.

One of the first to use the process in the South was the Carolina Fiber Company (now Sonoco), Hartsville, South Carolina, in 1926 for pulping gums. The pulp was blended with pine bisulphite pulp and made into butcher wrap. Since 1945 the production of semi-chemical has forged ahead of all other pulps except kraft, groundwood and bleached sulphite. It amounts to more than one million tons per year, two thirds of which is in the South. During 1953 it registered a growth of 180,000 tons, or an increase of about 30%.[3] Thus it appears to rival kraft for a place of leadership and it behooves scientists in Georgia to know something about it, as pulp and paper is more than a 200 million dollar enterprise in the state.

Pulping Procedure

Chips are charged into the digester and aqueous solutions of buffered sodium sulphite added. The amount varies with the yield desired, wood to be cooked and properties required in the pulp. For a 70% yield bleaching pulp, the amounts of sodium sulphite are in the range of 18-20 per cent on the basis of the dry wood.

Cooking is accomplished in 4-5 hours at a maximum temperature of 165-170° C and pressure of 100-115 lb. The pH is maintained so that the residual liquor is 6.8-6.9. The chips are blown into a receiver from which they go into refiners.

A *typical experiment* at Herty involved the use of 455 lb. of mixed oak, 152 lb. of gum screened chips in the 60 cu. ft. stainless steel digester with 252 gallons of cooking liquor containing 133 lb. sodium sulphite and 27 lb. of sodium carbonate. Thus the oak was 75% and gum 25% of the wood charged. The sulphite was 22% and the carbonate 4% of the dry wood.

The digester was brought to cooking conditions in 2½ hr. and held at 100 psi and 165°C for 6 hr. Control of the process was by means of residual sulphite and pH. At the beginning the active chemical was 63.3 g/l and pH 10.1. At the end it was 22.1g/l and

a pH of 8. The cooked chips were blown into a blow tank. Yield was about 70 per cent.

The function of the sodium sulphite in the cook is to delignify the wood and soften it enough so that the fibers can be separated. The sodium carbonate neutralizes the acetic, formic and tannic acids, preventing degradation from acid hydrolysis. Either individual species or mixtures may be used.

Defibering and Refining

The chips must be disintegrated and separated into individual fibers suitable for papermaking and washed. The disc type refiner is widely applied for this purpose. Because these pulps dehydrate

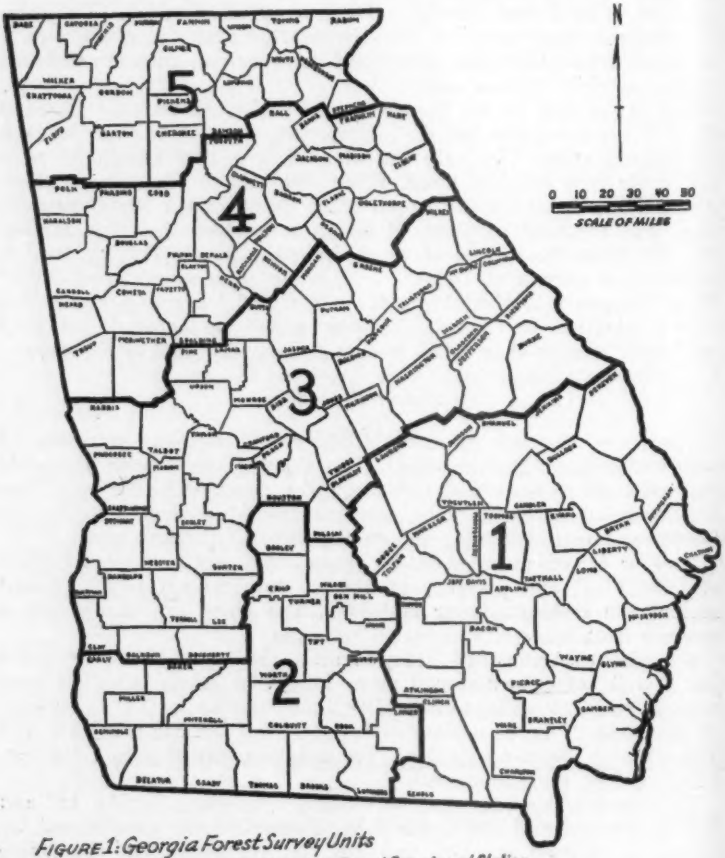

FIGURE 1: Georgia Forest Survey Units
By: E.L. Demmon, Director, Southeastern Forest Experiment Station

easily, the fiberizing action should be accomplished under mild treatment without prolonged mechanical attrition on the fiber as is done in many other types of refining machines.

As the semi-chemical pulps by different cooks differ in resistance to refining, it is also most important that different plate designs are available to adapt to the nature of the chips, degree of hardness, wood species, desired freeness and peculiar properties required. Defiberizing while hot and without drying out of the chips yields maximum fiber separation at minimum power expenditure. It may be concluded that semi-chemical pulp from many wood species is more sensitive and more easily damaged by mechanical treatment than kraft pulp.

Purification and Bleaching

When the inferior hardwoods which are difficult to debark are used, the resultant pulp contains more undesirable material that must be removed or bleached out when white papers are desired. This may be done by use of centrifugals and/or screening, which is illustrated by these samples of oak and gum unbleached pulp before and after the use of a Dirtec.

Simmonds and Kingsbury, *Paper Trade* J. *124*, No. 4, 53:60, January, 1947, have reported on bleaching of semi-chemical pulps by various processes. They can be bleached by processes used on sulphite, groundwood, or sulphate to a brightness of 75-80 per cent. Generally, a three or five stage process will give satisfactory bleached pulps using combinations of chlorination, alkali extraction, hypochlorite, sodium peroxide and chlorine dioxide. The oak pulp shown above required 22% total chemical to produce a pulp with brightness of 75 per cent.

Process Control Tests

In the process, control begins with a knowledge of the moisture content of the wood and determination of the composition of the cooking liquor.

Iodimetry in some form is the most important chemical tool. This is used for measuring the concentration of the sulphite solutions and residual in the spent liquors. It is employed to determine the amount of bleaching agents consumed and the bleachability of the pulps.

Throughout the process temperature and pH must be measured and controlled. Pressure is a factor in the cooking process.

Lignin content and freeness of the pulp are used as impirical measures of the chemical and mechanical work done on the wood. Lignin is an elusive substance which is generally obtained by removal of the carbohydrates with sulphuric acid and weighing the residue. It may be possible to establish a relationship between chlorine consumed and lignin content.[4] The freeness is a measure of the rate of drainage of water through a wet mat of standard weight of fiber and a sieve of standard weave.

Brightness is a comparison of the "color" with standard magnesium oxide of known color characteristics. It is used on bleached pulps only.

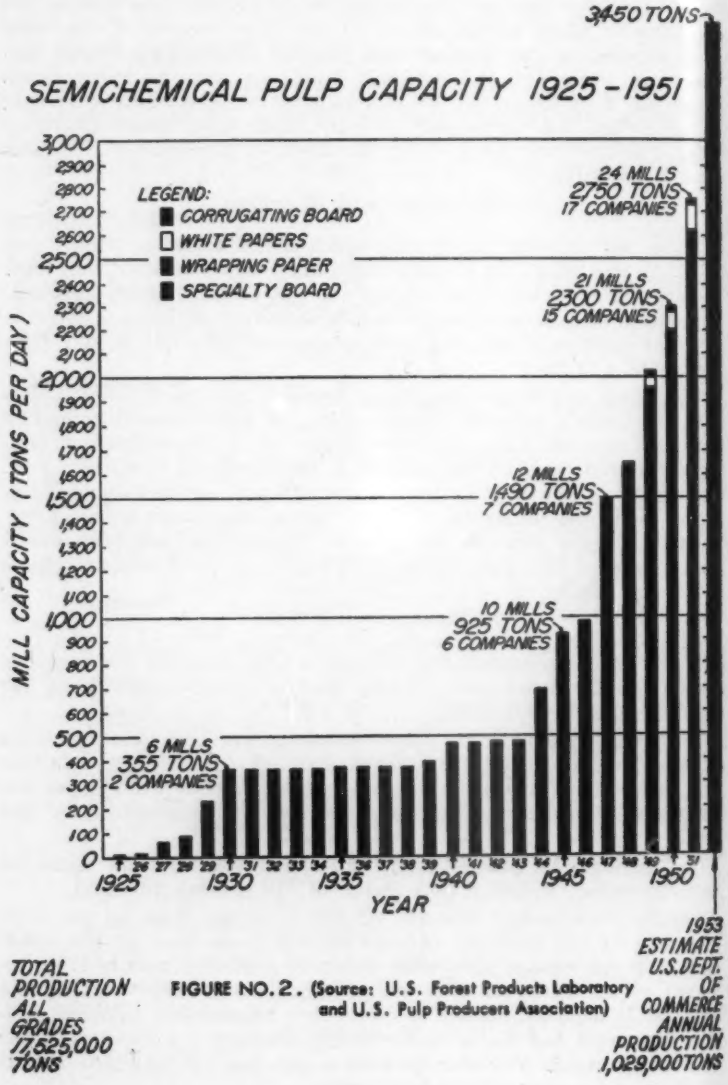

FIGURE NO. 2. (Source: U.S. Forest Products Laboratory and U.S. Pulp Producers Association)

Pulp Characteristics

The strengths of the hardwood semi-chemical pulps are appreciably higher than those of the sulphite pulps made from the same wood and approach the corresponding values for kraft pulp from the some wood. A high residual lignin may account in part for low strengths in some instances.

The strengths of the softwood semi-chemical pulps are higher than those of the hardwood pulps, but the softwood semi-chemical pulps have lower strength than the more completely delignified chemical pulps, such as kraft and sulphite.

The color of unbleached semi-chemical neutral sulphite pulps varies with the color of the wood. Some of these can be substituted for unbleached sulphite and show promise in newsprint.

Semi-chemical pulps are high in pentosans and tend to produce hard, brittle, stiff sheets. Thus they are well qua'ified for use as corrugating. These have high bursting strength, high tensile, and medium to low tear. More than one-half million tons are used per year in corrugating alone.

The bleached pulps have found most use as blends with other pulps in machine-coated groundwood book papers, in towelling, in bond paper, in newsprint, and in food-container board. They have been used successfully in making high quality glassine and waxing paper.

Problems Requiring More Study

As the neutral semi-chemical process applies best on hardwoods and because these have some properties distinctly different from the coniferous woods several problems need more study.

(a) It is not yet practical to remove more than 60-80 per cent of the bark from oaks and gums.

(b) With the inclusion of bark there is also a greater amount of dirt and encased knots, which yield shives, hard to remove or bleach.

(c) Economic recovery of diluted neutral sulphite waste liquor has not been effected, although several processes show promise. Each involves evaporation of relatively large volumes of water.

(d) Weight losses are high in the purification and bleaching. The short fibers and pentasons may be lost in the effluent.

(e) As no efficient recovery is available more organic is in the mill effluent, thus greater stream po!lution.

(f) The semi-chemical pulps are more sensitive than kraft or sulphite to chemical and physical forces, thus are more difficult to process. Stabilization of their properties is needed.

(g) Better methods of analysis, especially for determining what occurs in the process are needed for more effective process control.

(h) Less bleach consumption to reduce the cost of bleaching and rate of hydration.

Economics

The biggest item of cost in producing pulp is wood. As conventional kraft or sulphite 45-50 per cent yield of unbleached pulp is

the most to expect from pine; whereas, by the neutral semi-chemical process the yield will be 65-80 per cent of unbleached pulp from a variety of hardwoods heretofore uneconomical to process. Also a cord of hardwood weighs more than a cord of softwood, thus more weight of wood can be processed in a given volume digester. From the forester's point of view, the undesirable woods become economic to remove and the semi-chemical process becomes a sound forest conservation measure and should contribute much to a balance between the forest drain and the forest growth. The yield of bleached pulp is 10-15 per cent higher by the semi-chemical process than by the kraft or sulphite process.

Table I shows a comparison of estimated basic costs (wood, power, chemicals) for the high yield pulps and kraft with common costs omitted. Semi-chemical compares favorably.

TABLE I

	Estimated Costs	
	$/ton	
Unbleached Kraft—Conifers	34.53	
Semi-chemical Kraft—Conifers	31.46	
Semi-chemical Sulphite—Hardwoods	32.34	
Chemi-groundwood—Hardwoods	34.71	experimental
Cold Caustic Semi-chemical—Hardwoods	28.19	"

Conclusion. The neutral semi-chemical process shows great promise for growth because of its economic use to convert a wide variety of species of wood to a great number of paper products. It is predicted that pulp made by this process will, within a few years, exceed in volume all other pulps except kraft and may sometime be a strong competitor of kraft.

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SOME STRUCTURAL FEATURES OF ORDOVICIAN REDBEDS IN NORTHWEST GEORGIA[1]

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Location of Area

The area under discussion is in the strike belt of red, calcareous siltstones, mudstones, and interbedded limestones which crop out in Mill Creek Valley on the west side of Rocky Face Mountain, four miles west of the city of Dalton, Georgia.

1. Presented at the Annal Meeting of the Georgia Academy of Science, Dahlonega, April 23, 1954.

General Stratigraphy and Structure

The rocks of Ordovician age are predominantly red in color and represent a sequence of incompetent strata lying between two competent zones. These are: the Knox formation immediately underlying the "red beds" and consisting of chert and dolomite; a series of red, well-indurated sandstones and quartzites approximately 300 feet thick, overlie the red siltstones.

The area is located on the east limb of an anticlinorium as is indicated on the geologic map of Northwest Georgia, Butts (1946). During the process of folding, the weak siltstones have been dragged between the enclosing competent strata.

Coordinates of Deformation

The structures in this paper are referred to the triaxial coordinate system as used by Cloos (1949, p. 6): Axis "a" is in the plane of movement or transport direction. Axis "b" is parallel to the fold axis and perpendicular to "a." The "c" axis is perpendicular to the "ab" plane.

Cleavage

The rocks in the area show a cleavage which bears a relation to their resistance to deformation. There is an axial plane cleavage in the red siltstones and mudstones which fans slightly around the crest of the folds and transects bedding planes. Weathering along the closely spaced cleavage causes the rock to break into thin chips and slabs.

From a study of thin sections and polished sections, the cleavage appears to be predominantly associated with flowage (Cloos, 1951, p. 158) and partially the result of shearing. Gray, horizontally-bedded silt layers can be seen to be broken in several places by flowage of the red, finer-grained material through it forming cleavage planes at right angles to the bedding.

Figure I is a diagrammatic drawing showing cleavage-bedding relationships across the top of a fold. This outcrop cross-cuts the fold axis; cleavage is seen to be dipping at a high angle to bedding and can be seen to fan across the crest of the fold from 68 to 85 degrees. This resembles fan cleavage of Cloos (1951, p. 157). Unfortunately the fold was not completely exposed. Note that the structures on the west limb of the fold might easily be mistaken for bedding (Fig. 1). The weathering of the rocks along cleavage planes leaves the outcrops apparently dipping eastward, and if bedding is not observable, which is often the case, it becomes difficult to distinguish cleavage and bedding.

In Figure II, which is a diagrammatic sketch of an outcrop, the bedding (A) dips at a 61 degree angle from the horizontal, while the cleavage cuts the bed (B) at an angle of 83 degress from the horizontal. Bed (A) is a gray, calcareous siltstone, and has yielded by fracturing at angles almost normal to the bedding plane (greater than 75 degrees). Bed (B) is a typical red, fine-grained, slightly calcareous mudstone, and has yielded to deformation by flowage and

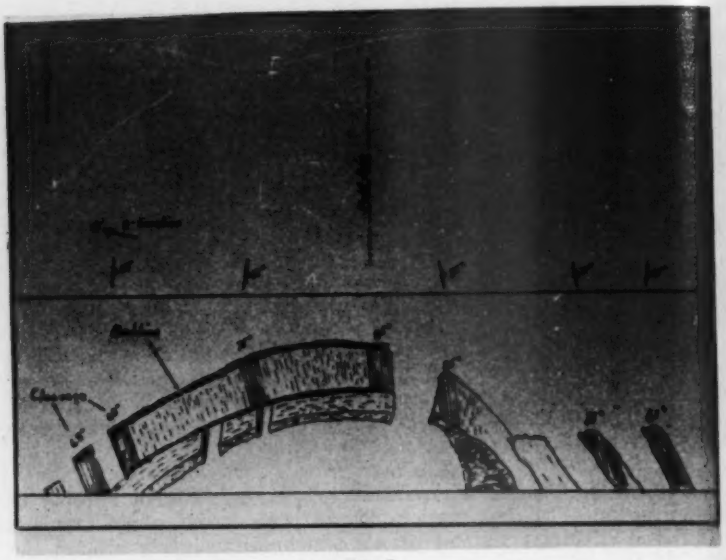

FIG. I

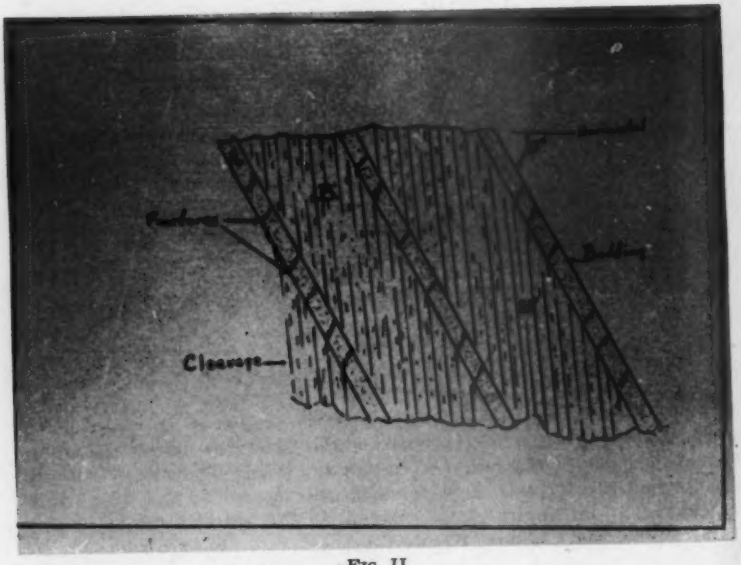

FIG. II

fracture. A polished section cut at right angles to the strike, shows that the red mudstone of (B) appears to have flowed into these fractures in bed (A).

A polished section, cut normal to bedding, reveals cleavage developing at an angle to the bedding (Fig. III). A peculiar feature of this cleavage is that instead of being straight as usually described, it can be seen to curve across the section. The intersection of the cleavage plane and bedding plane forms in "b" direction.

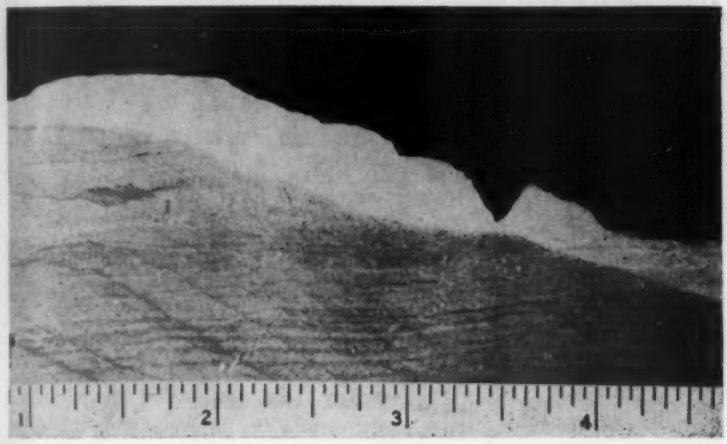

FIG. III

Lineation

Two linear directions are observed: The first is "a" lineation or transport direction, and is evidenced by striations on deposits of calcite along bedding planes caused by bedding plane slip during formation. Broughton (1946, p. 5) in his work on the Martinsburg slate, notes that this feature is most noticeable on the southeast limbs of folds. Lineation in "a" is also seen as striations and chatter marks on cleavage planes (Fig. IV), evidence that slippage has occurred along the cleavage planes.

The second linear structure is "b" lineation which shows a parallelism to the regional folding. This shows up on bedding surfaces and results from the intersection of cleavage and bedding planes. Broughton (1946, p. 6) states that because the flow cleavage normally lies in the axial plane of overturned folds, these intersections may be regarded as parallel to the fold axis. The "b" lineation was observed at only one locality on the east limb of an anticline, however, it is well worth noting that its lack of abundance is more properly a function of the lithology in that bedding planes are not as readily separated as cleavage planes which were the last planes of slip.

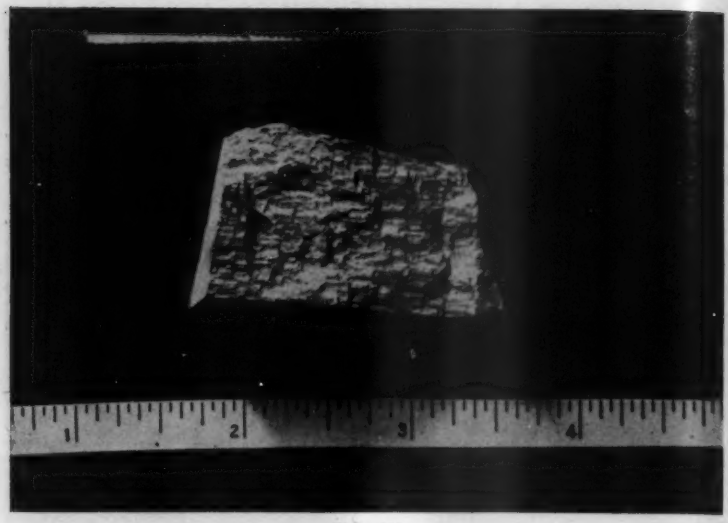

FIG. IV

Also noted here and throughout the area were tension fractures lying in the "bc" plane and filled with calcite. These fractures opened up subsequent to cleavage since they are not disturbed or offset.

Summary

The features mentioned above were all useful in working out the structure of the area: The axial plane cleavage which is seen to fan around the crest of the fold; the cleavage caused by flowage of the finer-grained mudstone which normally stands at a higher angle than bedding; the "a" lineation caused by slippage; the "b" lineation caused by the intersection of cleavage-bedding planes; are all useful criteria in location of the fold axis direction, determining the character of folds, and placing the outcrop in its proper relation to the larger structure.

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A STUDY OF SORTING IN SEVERAL SMALL STREAMS IN DECATUR, DEKALB COUNTY, GEORGIA[1]

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This study was undertaken to observe the degree of sorting in the material transported by a typical small stream of the Piedmont Province.

The four streams studied are located in the southeastern portion of Decatur, Georgia in the heart of the Piedmont Province. They are probably recent in age and are fed by a few intermittent tributaries. They originate in boggy springs along joint systems, and the total volume is added to by seepage, runoff, and domestic sources; however, the amount of water and sediment contributed by the additional sources is very slight and does not seem to influence the sorting coefficient of the streams. Clinkers and cinders from the nearby railroad contaminate the streams slightly. These streams form a small part of the great Altamaha system via South River and Ocmulgee River. The drainage pattern is dendritic, and in some places the course is choked with vegetation.

The deep weathering of the Piedmont has left a residual layer of red clay which is exposed where stream B (Fig. 1) has cut a gully some twenty feet deep through a ridge of decomposed biotite gneiss. The gully is indicated by hachure marks.

The upper courses of streams A and B are located in a biotite gneiss which contains small pegmatite dikes and amphibolite horizons. The junction of the streams is in an area of migmatite and biotite schist with a few small quartz veins penetrating the schist. The generalized contact (Fig. 1) was drawn on the basis of soil, float, and scattered small outcrops in the stream banks.

Samples of the material being transported by the stream were taken at the spots indicated by numerals on the map (Fig. 1). In the small tributary streams, A, B, and C, sample No. 2 is approximately thirty yards down stream from sample No. 1. Sample No. 3 was taken about fifteen feet below the junction of streams B and C. Each sample was dried in an oven and 200 grams of each taken for further use. Six wire screens of the A. S. T. M. Sieve Scale with mesh openings of 2.00. 1.00, 0.50, 0.250, 0.125, and 0.062 millimeters, and a pan, were used to size each 200 gram sample by running on a Ro-tap for five minutes. Everything below .062 mm. was collected in the pan. In Figures 2, 3, and 4 the bars of the histograms are arranged in the order listed above with the material from the 12 mm. screen represented by the bar to the left and the material from the pan by the bar to the right.

The amount of material left on each screen was then weighed and its percent of the 200 grams calculated. A cumulative percent

1. Presented at the Annual Meeting of the Georgia Academy of Science. Dahlonega, April 23, 1954.

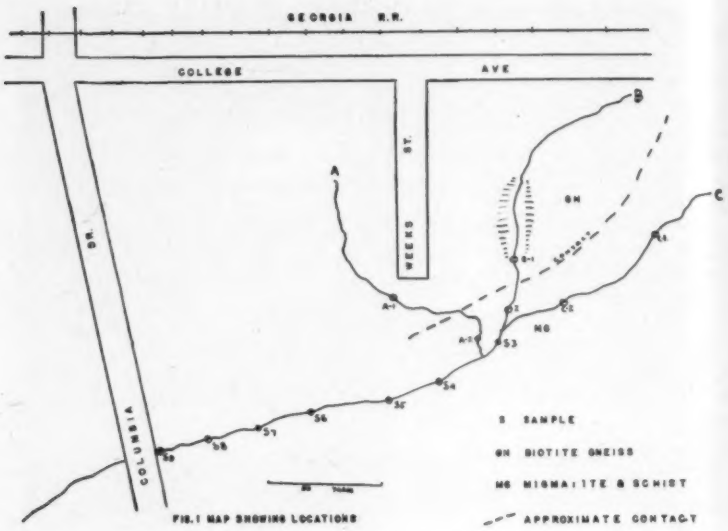

FIG. 1 MAP SHOWING LOCATIONS

was derived from these figures and a cumulative curve drawn on graph paper.

At this point a definition of "sorting" seems needed. According to Krumbein and Pettijohn (1938, p. 217) the central tendency of a sediment is "the grain size which is most frequent." Sorting then is the extent to which grains tend to be selected according to size, or the extent to which grains are dispersed about the central tendency. A very wide dispersion of grain size is poor sorting, a very narrow dispersion is good sorting. The degree of dispersion can be measured by various methods. In this paper the geometric quartile deviation method is used because it eliminates extreme particle sizes.

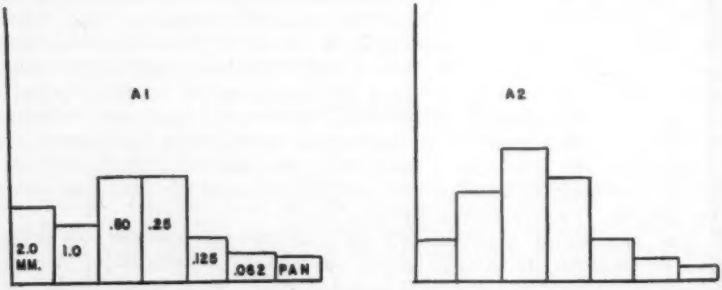

FIG. 2 HISTOGRAMS SHOWING DISPERSION OF GRAINS IN STREAM A

A quartile measure is that size value associated with the point where the 75 and 25 percent values intersect the cumulative curve. The size value for 75 percent is labeled Q1, the size value for 25 percent is Q3, and the actual sorting coefficient is derived from the square root of Q3 over Q1. This will always give a number greater than one. In other words, one would be perfect sorting and as the sorting coefficient approaches one, the sorting improves. This is a numerical expression of the fact that all the grains approach one size value.

The subject is best visualized by the histograms in Figures 2, 3, and 4 but in order to have a more specific point of reference the sorting coefficient is also given in the discussion of each sample.

The transported material taken from the bottom of stream A at A-1 (Fig. 1) has a widely dispersed size range (Fig. 2), is well dispersed over the size range, and the sorting coefficient is 2.19. Thirty yards downstream, at A-2 (Fig. 1), the grain size is concentrated toward the middle (Fig. 2). Sorting therefore has improved, and the sorting coefficient is 1.74. Thus, in thirty yards the degree of sorting increased from 2.19 to 1.74, an increase of .45.

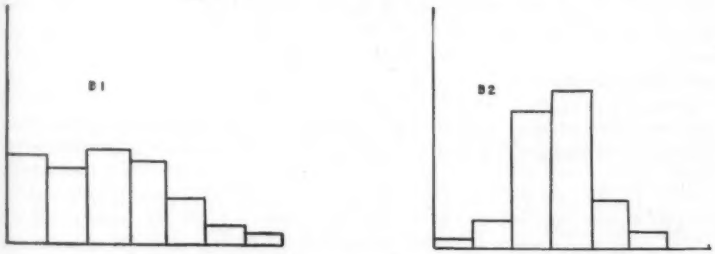

FIG. 3 HISTOGRAMS SHOWING DISPERSION OF GRAINS IN STREAM B

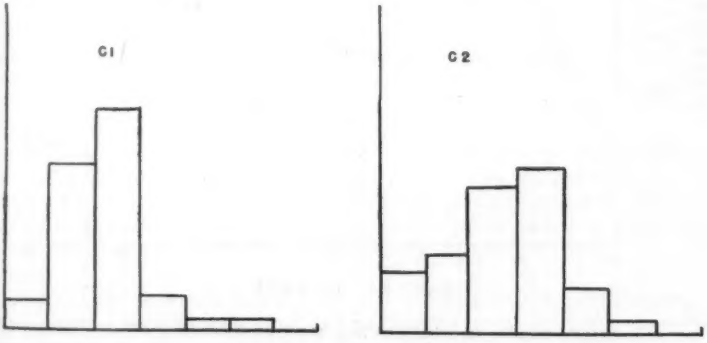

FIG. 4 HISTOGRAMS SHOWING DISPERSION OF GRAINS IN STREAM C

Again the transported material at B-1 (Fig. 1) has widely dispersed grain size with no great concentration of material on any one screen (Fig. 3). The sorting coefficient is 2.0.

At B-2 the majority of the grain sizes are concentrated between 0.50 mm. and 0.062 mm. (Fig. 3), the sorting coefficient being 1.55. Thus, sorting in stream B increased from 2.0 to 1.55 in thirty yards. The increase again being .45, the same as for stream A.

Stream C presents an entirely different picture. At C-1, grain sizes are observed to be fairly well concentrated (Fig. 4) with a sorting coefficient of 1.47.

At C-2 which is thirty yards downstream, the degree of sorting decreases to 1.55. The decrease between C-1 and C-2 is .08 and such a small number probably does not have any significance other than to illustrate the lack of change in degree of sorting (Fig. 4). It will be remembered that the entire course of this stream is in the schist formation (Fig. 1).

The variations in the degree of sorting along the main stream can best be illustrated by the graph in Figure 5. The sorting coefficient at points B-2 and C-2 is 1.55. Streams B and C then join to form one larger stream. Sample 3 (S 3, Fig. 1) was taken below this junction and shows that the sorting has increased to 1.42. The entrance of stream A into the main stream causes the sorting to decrease again to 1.6 (S 4, Fig. 5). It then begins to increase at a variable rate through sample 7.

Between sample 7 and 8 (Fig. 5) the degree of sorting decreases rapidly. The stream apparently crosses an unexposed quartzite belt because the stream bottom is covered by pieces of white to fleshy-

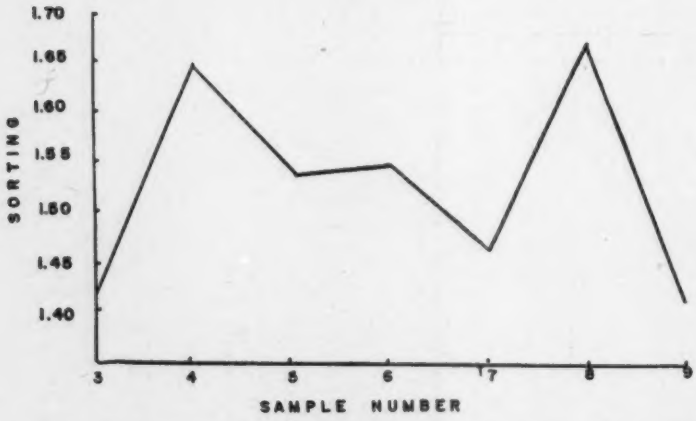

FIG. 5 GRAPH ILLUSTRATING CHANGE OF SORTING ALONG THE COURSE OF THE STREAMS.

red quartzite of all sizes. Below this point, the sorting coefficient again increases rapidly (S 9, Fig. 5).

Conclusions:

1. The degree of sorting by a small stream is in part controlled by the provenance of the stream.
2. The entrance of a tributary stream into another stream will cause the sorting to increase if the sorting coefficient of the tributary stream is lower than that of the main stream.
3. If a stream crosses any quartz rich rocks such as dikes, veins, or pods, this will cause the sorting to decrease.
4. Since the before mentioned conditions exist throughout the length of most streams in the Piedmont, sorting will never reach perfection.

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PENECONTEMPORANEOUS DEFORMATION IN THE SILURIAN RED MOUNTAIN FORMATION[1]

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The Silurian period is represented in Georgia by the Red Mountain formation. The following observations of this formation were made in the water gap cut by Chickamauga Creek through Taylor Ridge at Ringgold, Georgia. Taylor Ridge is a monoclinal mountain in which the beds dip 10 to 15 degrees to the southeast. The Red Mountain formation in this locality is composed largely of alternating beds of sandstone and shale and the individual beds are easily traceable for distances up to five hundred yards.

The interbedded sandstones and shales are interpreted to indicate that the formation resulted from relatively near-shore deposition. The sand grains are generally sub angular and range from medium sand (0.5 to 0.25mm.) down to silt-sized particles. The shales commonly contain a fairly high percent of silt-sized particles and some clear quartz grains of a larger size.

There is evidence that the clastic rock material in this area was brought in from a source to the southeast. This is demonstrated, in the regional picture, by the change from a predominance of sandstone in the most eastern exposures to a predominance of shale and some limestone in the exposures of this formation farther to the west.

Since this portion of the Red Mountain formation represents a near-shore environment, and the sediments were brought in from

1. Presented at the Annual Meeting of the Georgia Academy of Science, Dahlonega, April 23, 1954.

the southeast the original material was probably deposited on a surface sloping to the northwest. The original direction of dip was, therefore, opposite the present direction of dip in this locality.

There are various structures in the individual shale and sandstone layers that affect neither the overlying nor underlying beds. These structures seem to indicate a type of penecontemporaneous deformation, and are of two general types: interstratal flow and intrastratal flow. The former involves two or more beds, while the latter is restricted to a single bed. It is the purpose of this paper to discuss the appearance, occurrence and possible origin of these features.

One of the types of interstratal flow is seen in Figure 1. The sandstone and the shale layers are about three feet thick in this locality. The sandstone layer seems to have slumped down into the underlying shale, and small projections of shale extend up into the sandstone. To the east and the west of this feature the sandstone shows definite graded bedding, with the finer particles of sand toward the top of the bed. The sandstone within the structure shows no graded bedding, indicating turbid conditions at this point during, or soon after deposition. The shale projections are composed of the finest particles in the shale, none of the silt-sized particles or quartz grains being present. This is probably the result of partial consolidation in the shale bed prior to the time when the slumping occurred and also to the fact that the finer particles would normally migrate to the top of the bed.

A different type of structural feature occurs nearby. The sandstone layer appears to have folded into an anticline, but neither the overlying nor underlying beds have been disturbed. As is the

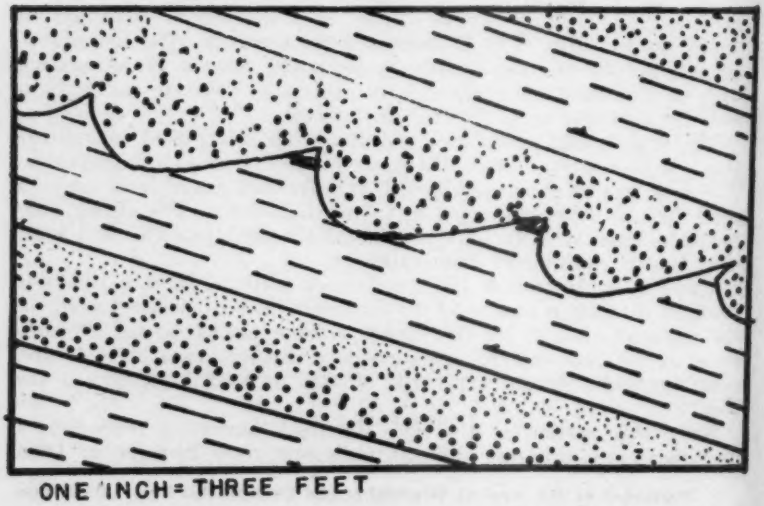

FIG. 1. *Structure of sandstone beds in the red mountain formation.*

case in the foregoing structure, the sandstone bed shows graded bedding to the east and west, but in the area of disturbance there is none, and a type of intrastratal flowage has taken place at the bottom of the bed. This seems to indicate that the sand layer was deformed before consolidation.

There are two general explanations for these structures, and it is probable that both forces were active in their formation. Since the original sediment was deposited on a surface dipping to the northwest, and these deformational features all seem to have moved in that direction, the most logical explanation is that they were caused by the pull of gravity on the still unconsolidated sediments. Experiment has shown that flowage in sediments can occur on slopes of 2½ degrees, and usually does occur in all sediments on slopes of more than 15 degrees.

Another possibility is the work of gravity currents moving along the ocean floor at the time of deposition. These gravity currents, or density currents, are caused by a large amount of suspended material in the water. This suspended material tends to make that portion of the water heavier and the pull of gravity sets up currents by pulling the denser water toward the deeper part of the basin of deposition.

All of the observed features seem to have been formed near the border of the Silurian continental shelf, or between the unda and clino environment of Rich.[1] That is, they were deposited near the break in the continental shelf as it steepens to plunge into the depths. This would be the typical locality for the formation of both the type of rock involved and the features themselves. The sediment apparently became deformed while still semiconsolidated and in it's subaqueous environment. The deformation was probably due to either the pull of gravity on the sediment, or the formation of density currents, or a combination of the two factors.

REFERENCE

1. John L. Rich, "Three Critical Environments of Deposition and Criteria for Recognition of Rocks deposited in Each of Them," *Bull. Geol. Soc. Amer.*, Vol. 62 Pt. 1, Jan.-June, (1951), p. 1.

ORIGIN OF GREEN CHERT UNDERLYING THE LOWER BENTONITE BED IN THE ORDOVICIAN SYSTEM OF NORTHWEST GEORGIA[1]

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INTRODUCTION

A green chert bed immediately underlies the lower bentonite bed in the Trenton formation of the Ordovician System in Northwest Georgia. The outcrops of the green chert are numerous and easily

1. Presented at the Annual Meeting of the Georgia Academy of Science, Dahlonega, Ga., April 23, 1954.

recognizable due to its persistence, its resistance to erosion, and its characteristic green to green-black color. These properties of the green chert have made it valuable as a stratigraphic marker bed or "key" horizon in the zoning and correlation of the Ordovician System in Northwest Georgia.

Procedure

Data was collected for this study from thin sections, polished sections, etched sections, and field observations. Each proved to be about equal in importance.

Descriptions and Results

The overlying bentonite bed has an average thickness of about four feet, and the green chert bed beneath has an average thickness of four inches. The contact between the top of the green chert and the bentonite is sharp, but the contact between the underlying limestone and the base of the chert is irregular, with inclusions of each in the other. Some of the inclusions of chert are found as much as three feet below the chert bed. The inclusions are rather small, usually no larger than the hand, and show no apparent orientation. The contact between the green chert bed and the underlying limestone and also the contacts around the inclusions appear sharp on a fresh surface, but etched sections (Fig. 1) made of the contact show a zone of gradation one-fourth to three-fourths of an inch wide. This zone of gradation in the field appears to be limestone, but after polishing and treatment with hydrochloric acid, it shows approxi-

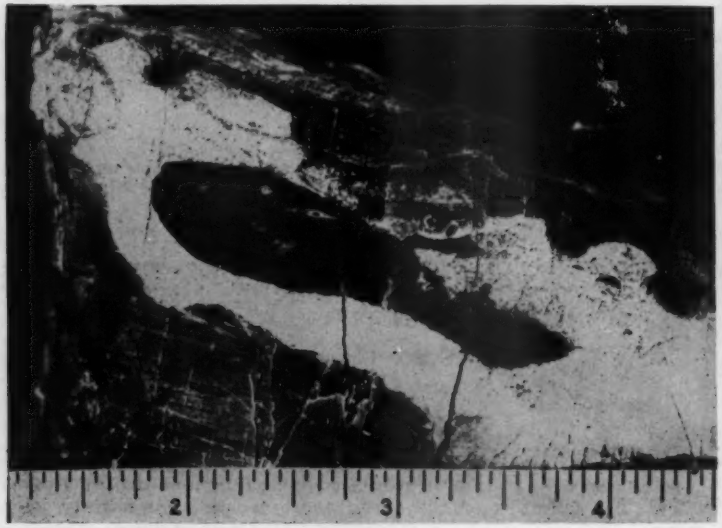

Fig. 1. *Limestone nodule surrounded by transition zone in turn surrounded by chert.*

mately 50 percent chert and 50 percent limestone, and photographs white as in Figure 1.

Fossils replaced by silicia are very abundant on the weathered surface of the chert (Fig. 2). Those which have been identified are *Zygospira, Rafnesquina,* some bryozoans, and crinoid stems.

In one locality, an outcrop of the chert exhibits well-formed ripple marks. They have symmetrical well-rounded apices, are approximately 5 cm. from crest to crest, and 13 mm. deep in troughs.

In thin sections, the ground mass of the chert is composed of cryptocrystalline quartz with scattered carbonate rhombs, which in some instances increase toward the limestone contact. No partial

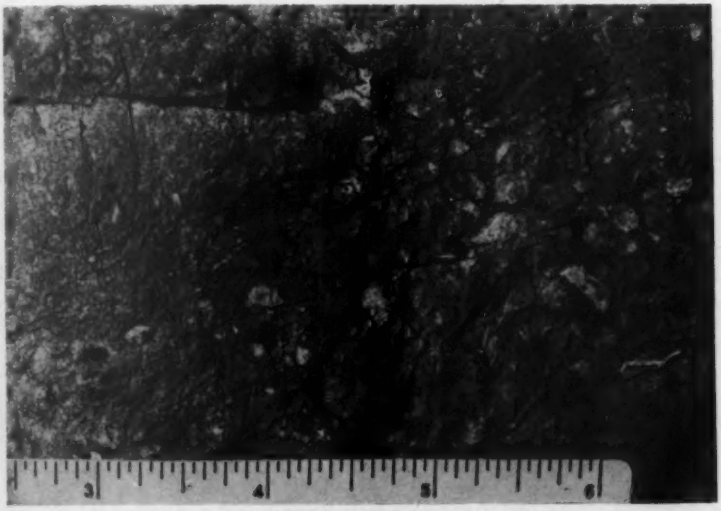

FIG. 2. *Silicified fossils in the green chert.*

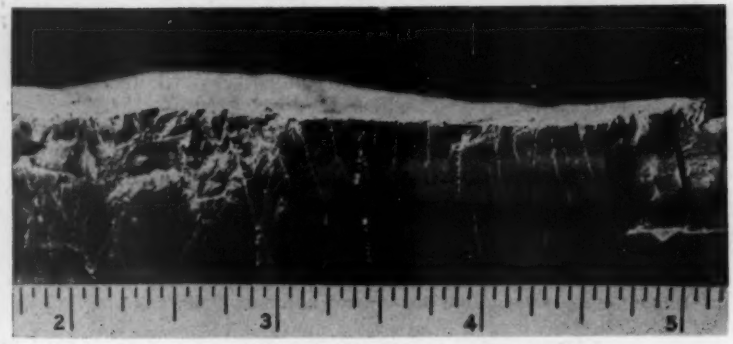

FIG. 3. *Calcite-filled fractures in the green chert.*

silicification of the rhombs was noted, but the small size would make this determination difficult.

Polished sections of the chert shows apparent remnants of bedding. Also, the chert contains many vertical fractures, most of which are filled with calcite (Fig. 3).

Conclusions

The author believes that from the evidence shown, the following conclusions can be drawn which point definitely toward a secondary origin of the chert.

1. In a replacement process, it would seem logical along the contact of the chert and limestone, there would be a zone where replacement is only partially completed. As observed above, there is a gradation from complete replacement to non-replacement and not a sharp contact.

2. The fossils which originally were calcareous and are now siliceous, offer definite evidence of replacement.

3. Ripple marks, according to Robert R. Shrock (1948, p. 95) "form in any sort of granular sediment but do not form in mud or in coherent granular material. Their presence in a sedimentary rock, therefore, is conclusive evidence that the sediment was granular at the time the ripple mark was formed." On this premise, the author concludes that a primary chert, formed from a silica gel would not have ripple marks. The ripple marks on the green chert bed, therefore, represent replacement of ripple marks formed in detrital limestone.

4. The contact between the limestone and the green chert bed, with the inclusions of each in the other, seems to offer definite evidence of a replacement origin for the chert. Of special importance is the presence of inclusions of limestone in the chert, as it seems improbable that they would form in a primary chert of such thinness.

Origin of Silica

As a possible source of the silica which replaced the limestone, the bentonite bed would be ideal. According to Charles Weaver, in his article on Ordovician potassium-bentonites (1953, p. 934), much of the silica of the volcanic ash is probably removed in the formation of the clay to which the bentonite has been weathered. Since the bentonite bed immediately overlies the chert, it would prove to be a reasonable source of silica.

REFERENCES CITED

Shrock, Robert R. (1948) *Sequence in layered rocks*, New York, McGraw-Hill Co., 507 pages.

Weaver, Charles E. (1953) *Mineralogy and petrology of some Ordovician K-bentonites and related limestones*, Geol. Soc. Am., Bull., Vol. 64, p. 921-944

REPORT OF THE SECTIONS

SECTION I

BIOLOGY SECTION

RESOLUTION FROM THE BIOLOGY SECTION TO THE GENERAL MEETING

GEORGIA ACADEMY OF SCIENCE

APRIL 23, 1954

WHEREAS, the information from various foundations regarding funds for research is not always available to competent investigators, particularly those not associated with universities,

THEREFORE BE IT RESOLVED, that members of the Academy send to the editor of the BULLETIN notices and other pertinent information regarding foundation funds in order to more wisely circulate this information.

That members of the Academy report grants which they receive so that the information may appear in the BULLETIN.

That the council consider ways and means of aiding the program to secure more foundation funds for Georgia scientists.

(Presented by Dr. W. H. Duncan)

At the business meeting of Section I the following were elected as officers for the coming year:

Dr. W. H. Duncan, Chairman; Prof. Thelma Howell, Secretary. Dr. M. S. MacDougall was elected council representative for three years.

SECTION III

EARTH SCIENCE SECTION

This Section met for the reading of papers on April 23, 1954 at Dahlonega, Georgia, where morning and afternoon sessions were held and a total number of seventeen papers were presented before a large audience. A large amount of research is now being done by Academy members in the various fields of Earth Science, especially geology, and with special emphasis on the geology of Georgia.

The Earth Science Section and the Georgia Mineral Society planned a gold panning trip near Dahlonega Saturday morning for other members of the Academy. This expedition was quite successful and everybody came away with gold.

The retiring officers are Miss Lewis Lipps, Chairman, and Prof. Romeo Martin, Secretary. Council Representative A. S. Furcron, who was elected President of the Academy, was succeeded by H. W. Straley. Mr. Nelson Severinghaus was elected Chairman and Prof. E. J. Parizek, Secretary.

R. J. Martin
Secretary

SECTION IV

PHYSICS, MATHEMATICS AND ENGINEERING SECTION

1953-1954

At the annual meeting of the Academy, twelve papers were presented by the Physics, Mathematics and Engineering Section. Of these, four were by invitation (see program). The men to present them were selected from the four fields of physics, mathematics, engineering, and astronomy. Each was asked to give an expository paper of some topic which might already be common knowledge to members of his own general group, but with which the members of the other three groups would not be well acquainted. These four men did excellent jobs, presenting important topics in very interesting papers.

The entire group showed active interest in all the papers presented. The Secretary of the Section is to try to collect the papers and to submit them to the editor of the BULLETIN for publication.

E. A. Bailey
Chairman, Section IV

SECTION V

PSYCHOLOGY AND MEDICINE SECTION

At the business meeting of Section V, held after the morning session of the annual meeting of the Georgia Academy of Science at Dahlonega, Georgia, the following officers were elected for 1954-55:

Chairman: Dr. Katherine T. Omwake, Agnes Scott College, Decatur, Georgia

Secretary: Dr. Emily Dexter. Agnes Scott College, Decatur, Georgia

Dr. R. Travis Osborne, president of the Georgia Psychological Association, announced that Dr. Omwake, the new chairman of the section, would represent the G.P.A. on the executive council.

As a special feature of the program of Section V, Dr. Daniel Billen, Oak Ridge National Laboratory, Tennessee, gave a splendid address, which was enthusiastically received, by the members and also by the numerous visitors who were present.

Florene M. Young
Chairman, Section V, 1953-54

SECTION VII

SCIENCE EDUCATION SECTION

The Science Education Section of the Georgia Academy of Science met at 2:30 p.m., Friday, April 23, in the Science Hall of North Georgia College for its first organized meeting.

A pertinent and scholarly paper on "Science and the Liberal Arts" was given by Dr. W. E. McNair of Agnes Scott College. This was followed by a paper on "What Industry Expects from the High School and College Graduate," presented by Mr. Daniel C. Kyker

of General Electric Company. Dr. Arthur Cohen of Oglethorpe University led the lively discussion which followed.

It appears that many students lack the ability to read intelligently, the ability to follow directions and the ability to observe accurately. This fault lies rooted-deeply in the elementary approach. Could these difficulties be surmounted, the high school and college could safely turn the graduate to a welcoming industry, which would give him technical and specialized know-how. Word power, spoken and written, is power indeed.

It is hoped that members interested in Science Education will begin now to consider contributions of papers for next year's program. Demonstrations of special techniques which have proven successful would also be welcome.

The group voted to combine, for the present, the offices of chairman and secretary.

Mrs. Helene Norwood Lammers was elected secretary for the year, 1954-55.

Miss Louise Stakeley was elected as representative to the Executive Council for a three year term.

Respectfully submitted,
Helene N. Lammers
Acting Chairman

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